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U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN 329.

Experiment Station Work,

XLVII.

Compiled from the Publications of the Agricultural Experiment Stations.

LOW-GRADE v. HIGH-GRADE FERTILIZERS.
IMPROVEMENT OF SANDY SOILS.
DRY FARMING.
SEED SELECTION.
EVERGREENS: USES AND CULTURE.
NUT GROWING IN MARYLAND.
"HOGGING OFF" CORN.
MINERAL MATTER IN FEEDING STUFFS.
PREPARATION OF MISCIBLE OILS.
AN AUTOMATIC CHEESE PRESS.
CANE SUGAR AND BEET SUGAR.

MAY, 1908.

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EXPERIMENT STATION WORK.

Edited by W. H. BEAL and the Staff of the Experiment Station Record.

Experiment Station Work is a subseries of brief popular bulletins compiled from the published reports of the agricultural experiment stations and kindred institutions in this and other countries. The chief object of these publications is to disseminate throughout the country information regarding experiments at the different experiment stations, and thus to acquaint farmers in a general way with the progress of agricultural investigation on its practical side. The results herein reported should for the most part be regarded as tentative and suggestive rather than conclusive. Further experiments may modify them, and experience alone can show how far they will be useful in actual practice. The work of the stations must not be depended upon to produce "rules for farming." How to apply the results of experiments to his own conditions will ever remain the problem of the individual farmer.—A. C. TRUE, Director, Office of Experiment Stations.

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EXPERIMENT STATION WORK.[a]

LOW-GRADE V. HIGH-GRADE FERTILIZERS.[b]

In a recent report of fertilizer inspection in West Virginia, J. H. Stewart and B. H. Hite call attention to the large amount of low-grade fertilizers used in the State and make an earnest plea for the use of high-grade materials, asserting that "it is very poor business on anyone's part to invest in low-grade fertilizers."

For every reason that may be assigned for using fertilizers at all there are always two reasons for using high-grade fertilizers, and the first is the saving in cost.

From the moment the raw materials leave the mine, slaughterhouse, or garbage dump until they are in the soil the cost of handling is one of the heaviest items the farmer eventually has to meet. Such expenses are the same for a ton of fertilizer containing 1 per cent of plant food as for a ton of fertilizer containing 2 or more per cent. The average freight bill alone on fertilizers shipped into this State is over $2. This and a number of like bills could, of course, be cut in two by purchasing fertilizers containing double the amount of actual plant food. The cost of hauling fertilizers from warehouses, cars, or boats to the farm is an item worth considering if only for wear and tear on horses and wagons. Why make two trips if one will do?

Concentrated high-grade materials necessarily command a higher price, but the difference is not always proportional to the difference in actual plant food, the high-grade materials as a rule being cheaper, pound for pound of actual plant food.

The statement is illustrated by comparisons of high-grade and low-grade fertilizers, the analyses of which are reported in the bulletin. The authors say:

If purchasers of commercial fertilizers would only get into the habit of calculating the number of pounds of plant food in a ton of every fertilizer in which they are interested they might often be surprised to note how much they might have saved on the quantities of plant food they have been purchasing, or how much more plant food they might have purchased for the same money.

But there is yet another and a better reason for using the concentrated fertilizers. It has to do with the fitness of the various sorts of fertilizer materials

[a] A progress record of experimental inquiries, published without assumption of responsibility by the Department for the correctness of the facts and conclusions reported by the stations.

[b] Compiled from West Virginia Sta. Bul. 114.

for supplying the needs of plants. As a rule that has but few exceptions, the more concentrated the materials from which the fertilizer is made the more suitable (or less objectionable) they are as food for plants.

It is pointed out that—

Farmers will get concentrated fertilizers whenever they decline to accept the other kind. By purchasing concentrated fertilizers they will save on the cost of actual plant food, and they will not get low-grade nitrogen and potash materials, for the simple reason that a concentrated fertilizer can hardly be compounded from low-grade materials.

IMPROVEMENT OF SANDY SOILS BY GROWING FORAGE CROPS.[a]

In farm management the maintenance of soil fertility is always a most vital problem, and on lands sufficiently fertile all that is necessary to prevent deterioration is to hold the crop-producing power of the soil at the same level. Adequate fertility in soils, however, is not very common, and generally the first question is how the fertility may be increased. The methods of soil improvement vary with different kinds of soil, and the difficulties encountered are largely determined by the soil character. Light soils, for instance, are usually much more difficult to improve than similarly located heavy soils. A consideration of this subject, together with the results secured in the improvement of the sandy soils in south Jersey by means of growing forage crops, has recently been presented by E. B. Voorhees and J. G. Lipman, of the New Jersey Experiment Station.

In discussing the general character of light soils, the authors point out that unimproved sandy or sandy loam soils can not furnish as much plant food or supply as much moisture to growing crops as the clay and clay loam soils are capable of doing. Attention is further called to the fact that the coarseness of sandy soils prevents them from readily retaining the plant food applied to them and the moisture they receive. The fertilizers given are easily washed downward into the subsoil by the rains, and dry weather soon robs these soils of their moisture. Extremely open or coarse, sandy soils are considered amenable to profitable cultivation only when the rainfall is abundant and well distributed, the subsoil sufficiently compact, and the water table near enough to the surface.

In treating of the physical properties of sandy soils, their relation to moisture, heat, and air is discussed. It is shown that owing to their great permeability sandy soils may be tilled early in the spring, when heavier soils are still too wet to be worked. They are earlier and warmer than heavy soils because they are drier. On the other hand, these loose and open soils quickly lose their water by both percolation and evaporation, and at the same time, on account of

[a] Compiled from New Jersey Stas. Bul. 211.

their limited capillary power, are unable to replenish this loss rapidly by drawing upon the water supply of the subsoil. In the heavier and more compact types of soil capillarity is much more active.

The openness of light soils admits air freely and thus intensifies the chemical and bacteriological changes going on in the soil. Under these conditions plant food is made available more quickly and the rock particles weather more effectively than under the conditions obtaining in a heavy soil, but these processes are carried on so rapidly that the humus burns out too fast and the losses of plant food are too great.

Chemical studies of the sandy soils of south Jersey reveal for the most part their poverty in plant food. Some soil samples examined contained as much as 98 per cent of pure quartz. Lime was found in small quantities, magnesia and potash in traces only, and the proportion of organic matter was also very low.

It is stated that the bacterial activity of soils is directly influenced by the supply of air, moisture, and warmth, and by the chemical composition. Well-aerated or open soils favor the development of bacteria requiring large quantities of air for their growth, and these species cause an intense decomposition of the humus. This is offset to a great extent by the rapid loss of water from these soils, as the bacteria can not multiply when the soil moisture falls below a certain point. In the heavier soils not so well aerated and not so readily affected by dry weather, the changes in the development of bacteria are not so sudden, and therefore the supply of plant food, and especially of nitrogen, is much more uniform than in the open sandy soils.

For the improvement of sandy soils it is recommended that thorough aeration be discouraged by methods of tillage, by applications of fine-grained materials or of substances readily pulverized, and by additions of large quantities of humus-forming matter such as green crops or barnyard manure. Sufficient humus in the soil prevents the too ready access of air and increases the moisture-holding capacity of the soil. Although sandy soils are quite poor in plant food this condition does not preclude the possibility of their improvement. Phosphoric acid and potash may be supplied at a comparatively small cost and the humus may be furnished in either animal manures or green manures. In considering this phase of the work the authors show that the use of animal manures is not indispensable. They regard horse manure as too expensive for general farm crops, because it is not always handy and also as injurious in some cases through the introduction with it of weeds and fungus diseases. The experiments they conducted were made with a view of showing that the humus content of sandy soils could be increased by means of

green manuring and the use of fertilizers alone. Systems of green manuring were found particularly effective in this connection on account of the relatively greater need of nitrogen and humus in light soils and their greater power to convert green crops turned under into available plant food. Leguminous crops, such as crimson clover, cowpeas, soy beans, vetches, etc., are recommended for this purpose because they add both humus and nitrogen to the soil. The limitations of green manuring enumerated are the use of large quantities of water by the crops, the need of an abundant supply of phosphoric acid, potash, and lime in the soil, and the drying effect of the green crops when plowed under. Where the rainfall is sufficient the disadvantages of green manuring are largely reduced.

With reference to the activities of germs in the soil it is stated that by increasing the amount of humus in sandy soil its water-holding capacity is increased and thereby a more uniform bacterial development and a more uniform supply of available plant food assured. The increase of humus in sandy soils encourages the growth of bacteria as a result of the greater content of organic matter and of moisture, and their development is discouraged on account of a less thorough aeration of the soil.

The nitrogen-fixing or nitrogen-gathering bacteria associated with the growth of leguminous plants find the conditions existing in sandy soils extremely favorable for their development and for the fixation of large amounts of atmospheric nitrogen. The facility with which the air circulates in these soils favors the formation of nodules on the roots of leguminous crops. It is pointed out that the nodule bacteria take considerable quantities of nitrogen or oxygen from the air surrounding the nodules, and as in sandy soils this air is frequently renewed the best conditions for the growth of the organisms are created. It has been observed that in compact, fine-grained soils, where the air does not penetrate so readily to greater depths, the nodules on the roots are all near the surface, whereas in sandy soils they are distributed lower down on the roots of the plants. Another factor strongly favoring the fixation of nitrogen in sandy soils is the comparatively small proportion of available nitrogen present in them.

It is pointed out that leguminous crops new to a particular region may fail to develop nodules because the proper organisms are not present in the soil. In south Jersey soy beans, alfalfa, and vetch are more or less new and may fail to develop nodules. In the experiments conducted soy beans grown on one plat during the first season failed to develop nodules, remained yellow and small, and evidently suffered for lack of nitrogen, while a crop of cowpeas on an adjoining plat grew vigorously and was of a dark color. The

soy beans had no nodules on their roots, while the cowpeas were abundantly provided with them, showing that the bacteria producing nodules in the two crops are not the same and that the soy bean germs are not naturally present in the sandy soils of south Jersey. When some earth was obtained from a field where a vigorous crop of soy beans had been raised and applied to the soils in question very satisfactory yields of soy beans were as a rule secured.

While large amounts of lime are not required for sandy soils, applications of lime are of value in that they encourage the formation of humus substances which help to fix potash and phosphoric acid. As lime encourages the activities of various kinds of soil bacteria and thus tends to hasten the process of decay and nitrification, sandy soils should be limed less frequently and smaller dressings should be given than in treating heavy soils. Ground unburned lime is likely to give better results than burned and slaked lime. One-half ton per acre of ground oyster-shell lime may show results on sandy soils while remaining entirely without effect on a heavy soil. It was observed that an adequate supply of lime is important in both heavy and light soils in promoting the growth of most leguminous crops, and especially of alfalfa and of various clovers.

With these different points in mind, the authors conducted an experiment from 1904 to 1907, inclusive, to demonstrate to what extent the crop-producing power of south Jersey sandy soils might be increased and the financial returns raised by the use of fertilizers, green manures, and the growing of forage crops in proper rotation. One acre of land divided into five plats was devoted to the work. The soil, fairly uniform in character, was distinctly sandy, with a large proportion of fine sand. In preparing the land 1,000 pounds of lime, 320 pounds of acid phosphate, 100 pounds of ground bone, 160 pounds of muriate of potash, and 150 pounds of dried blood were applied per acre. Three of the plats received each in addition a top dressing of nitrate of soda at the rate of 80 pounds per acre after the crops were well started. With the exception of the first season, two crops were harvested each year. The rotations included corn, wheat, rye, millet, beets, mangels, cowpeas, soy beans, vetch grown alone or with oats or rye, crimson clover, red clover, and alfalfa. The leguminous crops for the four years included five of crimson clover, four of cowpeas, three of soy beans, six of vetch grown alone or with rye, wheat, or oats, and one crop each of red clover and alfalfa. Although no effort was made to establish a complete soiling system, succulent forage was available for a considerable portion of the growing season. The returns from the land showed a gradual and marked increase. Excluding the returns of 1904, when only one crop was harvested, it is shown that the value of the crop per acre in 1905 exceeded the cost

of fertilizer by $46.92, in 1906 by $64.07, and in 1907 by $76.90. These figures do not include an allowance for the cost of seed and labor, as it was the purpose of the experiment to demonstrate merely that the growing of forage crops on light soils may be made both practical and profitable, while increasing at the same time the productive capacity of the land.

From the results obtained it is considered not unreasonable to assume that by systematic cropping and fertilizing millions of acres of sandy soils in New Jersey and other States of the South Atlantic seaboard now uncultivated and unproductive may be profitably utilized "for dairy purposes to supply local needs, and to furnish, besides, a supply of dairy products for the large centers of population more or less distant. * * * They emphasize once again that these lands have before them a prosperous future, and that some day they are destined to be the scene of intelligent farming and of highly profitable returns, where at present they are scarcely tilled at all."

DRY FARMING.[a]

The extraordinary interest in so-called dry farming which has been awakened in recent years, and the rapid taking up of land for that purpose has emphasized the importance of a careful study of the conditions, possibilities, and limitations of the practice.

J. J. Vernon, of the New Mexico Station, has made a thorough study of the conditions and possibilities of successful agriculture by dry-farming methods in certain parts of that Territory. In defining the term dry farming it is explained that the practice includes "(1) deep plowing before the rainy season sets in, in order to provide in the soil a capacious water storage reservoir and an ample space for root development; (2) light, deep, even seeding or planting in a well-prepared, moist soil; (3) frequent, thorough, level cultivation before as well as after sowing or planting; (4) the use of seed bred and selected for the conditions prevailing; (5) the use of machinery of large capacity; (6) the adoption of methods for the concentration of crops."

In the earlier operations of agriculture in this as well as other countries the most fertile areas were the first to be brought under cultivation. This was often determined by the vegetation already growing upon the land in a wild state. Since it is well known that the right amount of water properly distributed throughout the growing season in a very large measure determines the productiveness of a soil, hence those areas over which the rainfall was abundant and well distributed were occupied and cultivated first. As the population increased those areas less favorably situated and not so well watered were

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[a] Compiled from Colorado Sta. Bul. 123; New Mexico Sta. Bul. 61; U. S. Dept. Agr., Bur. Plant Indus. Bul. 103. See also U. S. Dept. Agr., Farmers' Bul. 262, p. 15.

occupied. The seeking for new areas has gone on until the lands [heretofore considered only fit for range purposes on account of scanty rainfall] are now being brought under cultivation.

It is pointed out that coincident with the bringing in of less valuable areas, the work of the organized agencies of agricultural investigation and of the educated and thoughtful farmers have wrought wonders in the improvement of farm practices.

Inventive ingenuity has supplied improved machinery with which many operations are rendered practical that were heretofore either impossible or impracticable. With the new methods of handling soils and with the advance in the knowledge of methods, crops are now successfully grown on what are termed dry farming areas.

With the same methods and machinery these lands could have been cultivated with the same degree of success many, many years ago had there been the necessity. However, it must be remembered that there is a limit even at the present time to which we can go, although the investigations of future years may disclose methods whereby the present limits may be far surpassed.

There are three general groups into which the agricultural lands of the Territory, so far as dry farming is concerned, may be placed: (1) Sections where crops can be grown annually; (2) areas where crops can be grown only biennially; and (3) lands where the rain and snow fall is insufficient for regular crop production. Such grouping will not hold good throughout a long series of years, for it may and no doubt will happen that during a series of dry years, in sections where crops have been grown annually, crops can be produced only biennially.

As regards crops suited to dry farming Professor Vernon says:

There is quite as large a range for adaptation, amelioration, and breeding with dry farming crops as with those grown under humid conditions. The necessity for such effort is far more urgent, and the reward quite as promising.

Crops must be selected or developed that will fit the environments, and there seems to be quite as large a field for investigation in the improvement and development of crops suited to the various conditions in the dry farming sections as in the improvement of methods of handling the soil. * * *

There is little doubt but that strains of seed of certain crops which have been successfully grown for years under trying semiarid conditions will be in great demand. As a result of this demand we may reasonably expect pedigreed dry farm crops to appear and they will fill an important want.

Some of the crops which have been especially suited to dry farming are—

(1) **Cereals.**—Wheat stands at the head among the cereal crops for dry farming areas and it probably stands at the head of all crops for this purpose when everything is considered—adaptability to dry farming conditions, cost of production, profits, etc. There are certain classes of wheats that do best under droughty conditions. The durum or macaroni wheats seem to do exceedingly well when compared with other classes, yet there are varieties among other classes which also do well on dry farms. Spelt, oats, rye, and barley are all used on occasion. Barley is probably the poorest crop mentioned, because it is

comparatively a shallow rooted crop and for this reason likely to prove less valuable than a crop which forages more deeply for its food.

(2) **Sorghums.**—Both saccharine and nonsaccharine sorghums are grown. Fodder cane, Kafir corn, Jerusalem corn, and durra belong in this class. They should be sown for hay with a hoe drill or planted with a corn planter and cultivated. The sorghums may also be double rowed, i. e., planted in groups of two rows about 8 inches apart and cultivated.

(3) **Millets.**—Among the millets are found some of the most paying dry farm crops. Some of them grow and mature with a remarkably small amount of moisture present in the soil and at the same time the period of growth is very short.

(4) **Legumes.**—There are a few legumes that have shown value as dry farm crops. Peas, beans, and alfalfa are the most promising, although in order to secure a stand of alfalfa it will very probably require summer fallowing one year in order to accumulate sufficient moisture to insure perfect germination. After a stand is secured alfalfa has given good results in some sections. The alfalfa should be sown with the hoe drill and rather deeply for such small seed.

(5) **Vegetables.**—Garden vegetables form an important group. They add so greatly to a bounteous table supply. Many vegetables grow to the proper stage for consumption in a few weeks, and therefore are surer than almost any other class of crops. If markets are available they may be made a source of considerable revenue.

(6) **Trees.**—Both fruit and shade trees are grown in districts where dry farming is practiced. The home surroundings may be made more comfortable and greatly improved in appearance by the free use of shrubs and trees. The same care, however, must be exercised in the selection of the kinds to plant and in their care as is used with field crops. The first two or three years, until they become deeply rooted, is the most critical period in the life of a tree or ornamental shrub. Cultivation during that period should be constant and thorough.

Among the practical suggestions regarding methods of culture and the reasons for their adoption made by Professor Vernon as a result of his observations are the following:

Fall seeding of cereals is preferable to spring seeding wherever the conditions will permit for the following reasons: (1) The work is distributed over a longer period; (2) the root system of the crop becomes well developed, so that spring growth is more rapid; (3) the growth above the surface of the ground, though sometimes small, serves a valuable purpose by modifying the windsweep at a time when its effects are most marked, thus preventing, in a measure at least, the blowing of the soil from around the roots of the plants, and, at the same time, holding the snowfall upon the ground until it melts; (4) the crop covers the ground earlier in the spring, thus reducing the loss of moisture through surface evaporation; (5) the crop usually ripens earlier, a feature that is important for two reasons: (1) The work of preparing the ground for the next crop can be begun earlier, and (2) the crop may escape frost more frequently in sections having short seasons.

It is important to retain the snow upon the land, especially in sections where it forms a large part of the total precipitation. The snowfall may be retained in several ways: (1) By leaving the ground rough when the plowing is done late in the fall; (2) by throwing up borders across the field at right angles with the prevailing winds as winter approaches, and (3) by planting hedge

rows or shrubbery across the field at short intervals. The last-named method is preferable wherever possible.

Usually less seed should be planted per acre under dry farming conditions than is used in humid sections. The less the precipitation the smaller should be the amount of seed planted.

Finally, Professor Vernon warns those who undertake dry farming that " the yields in dry farming belts may be and sometimes are very large, but it is not best to expect as large yields in dry farming belts as are secured in humid sections, unless the cultural methods are very much superior."

J. E. Payne, of the Colorado Station, who has spent many years studying the agricultural conditions and possibilities of the dry "plains" of eastern Colorado, gives the following brief practical advice to that class of new settlers in this region " who have merely enough capital to put up houses, break a few acres of sod, and live during the first six months. * * *"

(1) If you have a milch cow give her the best care possible, and get as many more as you can. Sell cream, or make good butter or cheese. Sod cowhouses are within the reach of all who can work.

(2) Keep as many hens as you can take care of. Feed well and protect from coyotes and other beasts of prey. If you can raise turkeys and geese they will pay. Turkeys and geese may be herded by children, and turkeys are the best grasshopper exterminators known.

(3) For field crops on sod, plant early amber cane, yellow milo maize, and corn. The seed used should be grown in the vicinity if possible; if not, choose some early variety. If you are able to do so, prepare a small field for fall wheat.

(4) Plant a garden. If you have no well, plant a small plat near the house and water it with the waste water. Bury every drop of waste water beside some vegetable by making a furrow beside the plants, and after the water has sunk away fill the furrow with dry dirt. Old tin cans sunk in the ground by the side of hills of cucumbers aid in watering them economically. Punch holes in the bottoms of the cans.

If you have a well, plant a large garden, but plant all garden stuff in rows so that it may be cultivated with horse power. Use the water with the same economy that you would if using only waste water. Never flood the ground purposely. If any should be flooded, stir it thoroughly as soon as it is dry enough.

It is a common mistake with beginners in irrigation to try to make water take the place of cultivation. The result is failure. Another common mistake is to plant a larger area than can be watered from the well. Better begin with only a few square rods and extend the area as experience dictates.

In case you can not irrigate from a well, select a small patch of ground upon which you can turn the flood water from the prairie by means of furrows. If you can make a small reservoir above the patch, do it. The reservoir may hold a few barrels of water until you have time to direct it to the plants which need it. Cultivate thoroughly and keep all weeds down.

Besides the small truck, a good patch should be planted to Mexican beans, early cowpeas, watermelons, muskmelons, stock melons, pumpkins, squashes, popcorn, sweet corn, and potatoes. These will sometimes bring good crops

without irrigation. Enough should be planted so that a plentiful supply of winter food for the family will be assured. Stock melons are very productive, and if stored in sod buildings, above ground, they will furnish green food for the milch cows during winter. I have grown stock melons at the rate of 20 tons per acre. I have kept ordinary watermelons until the last of November by packing them in hay and storing them in a room where they kept cool but did not freeze. There are varieties of winter watermelons and muskmelons which are good from Christmas until March.

By planting the following seven varieties of sweet corn on the same day—and often near the last of May—I have had roasting ears from July 26 until September 26. The varieties were: Cory, Black Mexican, Perry Hybrid, Stowell Evergreen, Country Gentleman, Mammoth Evergreen, and Egyptian. The large varieties may be dried for winter use or allowed to ripen to be used parched. Parched sweet corn is a luxury, but one which is within the reach of the poorest settler. White Pearl and Queen Golden popcorn have done well for me, and my family have had many meals consisting only of whipped cream and popcorn.

Potatoes, squashes, and pumpkins may be grown successfully by keeping up a constantly successful fight against potato beetles and squash bugs. This means to battle almost daily with the pests from the time the potatoes are up until the middle of August, and from the time the squash plants are up until the squashes are ripe.

Grasshoppers are the worst enemies to field crops, but by keeping plenty of poultry the grasshoppers will be kept down.

To produce crops of any kind may require an amount of labor which seems enormously out of proportion to the market value of the produce, but we assume that people who have settled here desire to build up homes and they have come here because they failed to get homes elsewhere. It may be a comforting thing to remember that you may not be working any harder here while trying to establish independence than you would be if working by the day for some one for just enough wages to support yourselves.

A careful study of the natural conditions and the methods successfully employed in dry farming in the Great Basin has been reported by Mr. C. S. Scofield, of the Bureau of Plant Industry of this Department. The following is a summary of this report:

Dry farming in the Great Basin is limited at present almost entirely to the State of Utah, where it has been carried on to some extent since 1875 and its practice has been increasing rapidly since 1900. The work was initiated by private experiments, but the State of Utah is now supporting six experiment farms for testing varieties and working out scientifically the best rotation and tillage methods.

The precipitation comes during the autumn, winter, and spring months, differing in this respect from the precipitation on the dry lands east of the Rocky Mountains, where it comes during the summer months. Farming is successfully carried on with an annual average rainfall of 15 inches or slightly less. The annual variation in rainfall is considerable, and the year 1906 was unusually wet. Local topography has a marked effect on the amount of rainfall.

Clean summer fallowing and alternate-year cropping, together with thorough tillage, are the basis of successful dry farming in the Great Basin.

Wheat and alfalfa are the most important crops now grown on the dry lands of the Great Basin. Thin seeding is found essential to the best results with these crops.

Under the best methods of tillage the land appears to remain highly productive, even where no other crop than wheat is grown.

Dry farming is now used only as a supplement to irrigation farming. There have been few attempts to make homes on the dry lands.

The independent extension of farming on the dry lands depends upon the development of underground water for domestic use.

It thus appears that by means of special methods of culture and the use of drought-resistant crops a considerable amount of dry farming may be successfully practiced, particularly if supplemented by sufficient irrigation to insure garden products and forage for stock during seasons of crop failure on the unirrigated portion of the farm.

SEED SELECTION.[a]

As Dr. G. E. Stone, of the Massachusetts Station, points out, "it is generally recognized that large, heavy, and well-developed seeds will, as a rule, produce larger plants than light and poorly developed seeds of the same variety. It is also recognized that seed uniform in size, weight, and development will produce crops of a more uniform type than those grown from seed characterized by variations in development, etc."

He points out, however, that while "seed separation has come into vogue among growers of special crops as a means of securing more uniform crops and plants of greater vigor, [and] seed selection of one kind or another has been in vogue from time immemorial," special methods of selection are not at the present time common in the case of many crops, and he believes that much more attention might profitably be given to the matter.

Doctor Stone describes various methods which have been used for the separation and grading of seeds. "The separation of seed by sieves is one of the simplest, easiest, and most practical methods employed and is applicable to a large number of varieties; [but] small, light seeds are best separated by the air method, and various devices are used for this purpose." A form of the tube and bellows method referred to in former bulletins of this series [b] has been found to be well suited to such seeds and is described as follows:

The principal features of this device consist of a foot bellows, a glass tube three-fourths or more inches in diameter and 2 or 3 feet long, and a separate air space to receive the air. (See fig. 1.) The bottom of the tube must be covered with cheese cloth with a large enough mesh to allow the air to readily pass through, but fine enough to hold the seed. The pressure of the air and the diameter and length of the neck are features which must be adjusted to one another to secure the best results. Various kinds of blowing appliances are used, all having the same object—to properly separate the seed. For our purposes we have devised an apparatus (fig. 2) consisting of a series of tubes placed in a block side to side, and while certain ones are being operated others

[a] Compiled from Massachusetts Sta. Bul. 121.

[b] U. S. Dept. Agr., Farmers' Buls. 225, p. 10; 237, p. 12.

can be emptied and refilled. The tubes are set in holes and imbedded in paraffin, rendering them secure. The block holding the tubes is in two sections, and the two halves are held together by large screws. The tube extends to the middle of the block and rests upon a square piece of folded perforated tin "r," between which is placed bolting cloth, preventing the seed from falling through. The perforated tin and bolting cloth, which cover the lower end of the tube, are held in a horizontal position by means of a spring, and when the seeds are separated by turning the handle marked "Y" it brings the seed support in a vertical position, as shown by the dotted lines "Y," emptying the seeds into the Mason jar below "G," which is provided with a metal cover securely and permanently fastened to the under side of the block. The process of emptying the seed from the tube into the jar is easily accomplished and saves much time and labor. The top of each tube is provided with a light brass funnel having a simple shut-off at "e." Fastened to the same axis which carries the funnel there is another support which carries a bent piece of glass "t." This is for the purpose of directing the light seed into the cylinder "M." Both the funnel and the glass tubes are centered over the long tube and held in position by a simple click or spring at "O-C," and either can be readily swung in any direction. The blowing arrangement consists of a hydraulic air compressor provided with a 50-gallon tank, "A-D." This is connected with thick-walled rubber tubing, pressure gages, reducing valves, and shut-offs. The pressure is obtained by means of water, and with a large supply tank and high pressure the air supply can be kept quite constant. A special feature of this apparatus consists in the bulbs in the tubes, of which various types are used. In successful separation much depends upon the number and size and shape of these bulbs.

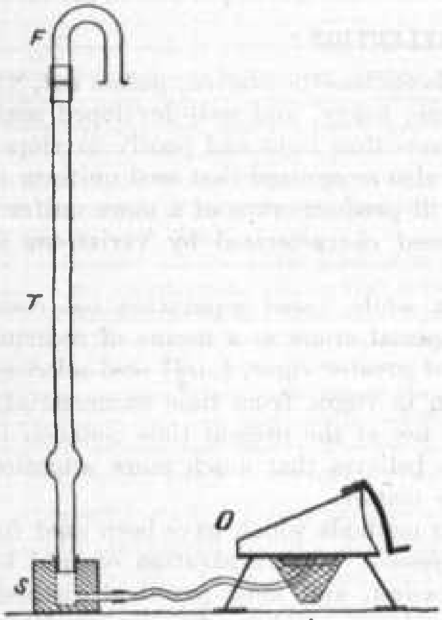

FIG. 1.—Simple device for separating seeds by tube and bellows method.

The results obtained by Doctor Stone with a number of crops confirm those of Shamel and Cobey with tobacco,[a] showing that seed separation is "an important aid in securing larger, more vigorous, and more uniformly developed crops."

EVERGREENS: USES AND CULTURE.[b]

W. J. Green and W. E. Bontrager, in a bulletin of the Ohio Station, urge that on account of their enduring foliage evergreens possess peculiar value both for shelter and ornament, and "should be

[a] U. S. Dept. Agr., Farmers' Bul. 287, p. 12.
[b] Compiled from Ohio Sta. Bul. 190.

more extensively planted about country homes, whether used in straight-row windbreaks or mingled informally with other trees on the lawn."

From the ornamental standpoint, they abound in rich dark shades of green, equally valuable as a background for deciduous trees or flowering shrubs and plants. * * *

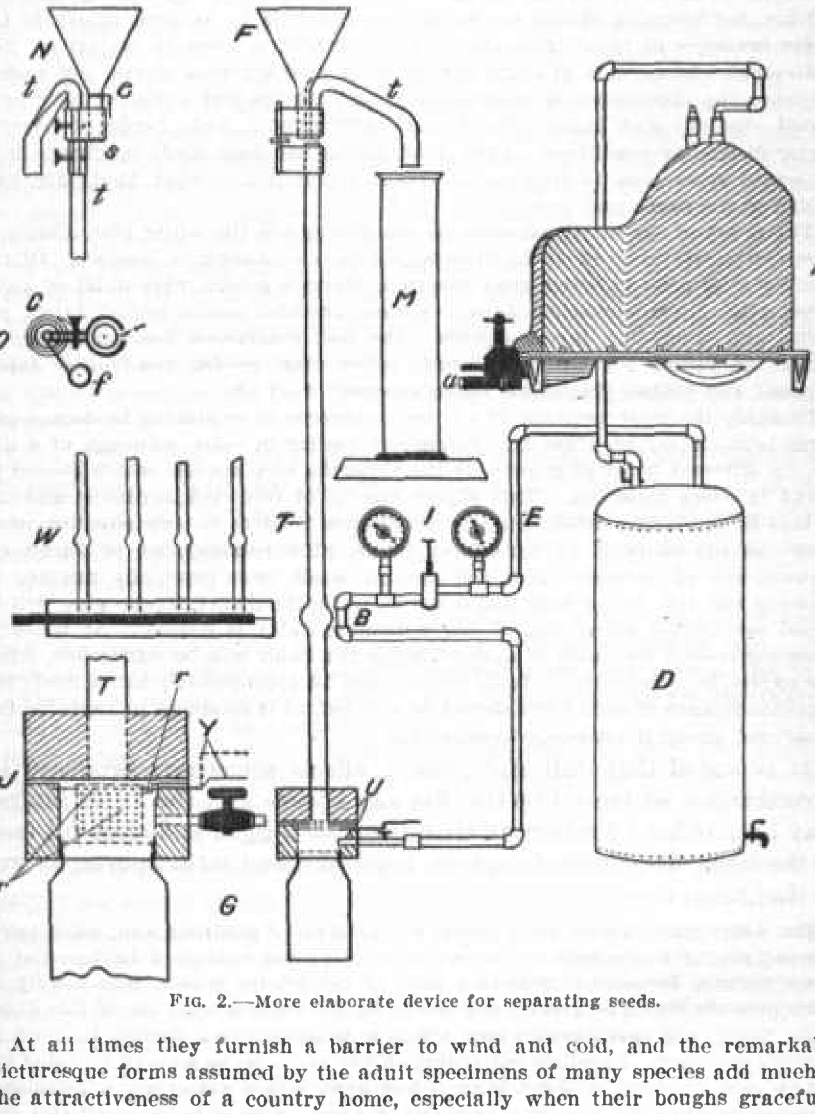

FIG. 2.—More elaborate device for separating seeds.

At all times they furnish a barrier to wind and cold, and the remarkably picturesque forms assumed by the adult specimens of many species add much to the attractiveness of a country home, especially when their boughs gracefully bend beneath a load of snow. In winter, when other trees are destitute of foliage, these majestic trees lend to the scene an air of animation which mitigates in a large measure the severity and desolation of the season. If tastefully intermingled with other trees and shrubs about the home they give a

warmth of verdure and variety of outline unattainable without their use. That many of the evergreens can be successfully grown upon thin sandy soils is an additional argument in their favor.

Where grown to show the characteristic beauty of individual trees, evergreens should be grouped naturally and not so closely as to crowd upon each other, usually along the sides or at the rear of the lawn. Planting in straight lines should be avoided, and, in small groups, the disposition of trees in odd numbers is to be preferred. Immediate effects may be secured by planting thickly, but thinning should not be so long deferred as to work injury to the lower branches of those trees which it is intended to grow to maturity. The individual who expects to begin the planting of evergreens should not underestimate the importance of ascertaining what species and varieties have been found vigorous and hardy after being tested over a wide range of country under dissimilar conditions. After a beginning has been made specimens may be added from time to time as the planter determines what kinds are best suited to his needs and locality. * * *

The finest of the larger ornamental evergreens are the white pine, Colorado blue spruce, white or silver fir, oriental spruce, and American hemlock. Of the smaller ones none is better than Siberian, Hovey's golden, pyramidal or globe arbor vitæ, thread-branched Japan cypress, graceful obtuse-leaved Japan cypress, and plume-like Japan cypress. The best evergreens bearing foliage in shades of yellow are George Peabody arbor vitæ, golden pea-fruited Japan cypress, and golden plume-like Japan cypress. * * *

Probably the most valuable of all the evergreens in producing landscape pictures is the silver or white fir. Somewhat similar in color, although of a distinctly different habit of growth, is the Colorado blue spruce, which should be found in every collection. This superb tree is of iron-clad hardiness and the foliage is of a pronounced shade of blue which renders it very effective when grown in proximity to darker-colored kinds. The retinosporas, or Japan cypresses, are an extensive group of elegant small trees especially adapted to massing and also to use upon small lawns, while the dwarf Mugho pine will be found serviceable where one of low spreading habit is desired. At times in grouping trees a specimen of upright, columnar habit will be admissible, when the pyramidal arbor vitæ or Irish juniper may be appropriately introduced; but a preponderance of such trees should be avoided, as it conduces to anything but a natural, graceful landscape composition.

It is stated that dull and gloomy effects sometimes produced by excessive use of trees like the Norway spruce and the Irish juniper may be avoided by mingling with them such light and cheerful trees as the silver firs, Colorado spruce, hemlocks, and retinosporas, as well as deciduous trees.

The white birch is admirably suited to this style of planting, and, when interspersed among evergreens, its snowy bark gleaming against a background of green boughs, becomes a charming part of the winter scene. The beauty of home grounds would be greatly augmented by the more general use of this handsome, hardy, and easily grown tree, which is so attractive a feature in much of nature's grouping. Excellent enlivening effects may also be secured by using the red-twigged dogwood, a shrub some 5 feet high, whose numerous, wine-colored branches contrast finely with evergreens or snow. Owing to its small size this must be grown in front of taller trees, or in nooks such as frequently occur along the edges of an evergreen group. As a companion plant to the dwarf dogwood the golden willow is sometimes used, thereby throwing golden twigs into con-

trast with those of a crimson hue. The foliage of the golden elder, a hardy, rugged shrub of the very easiest culture, will be of material value during the summer months. This must be planted in full exposure to the sunlight, as the rich yellow foliage becomes greenish in color when grown in partial shade. The coloring of this shrub is finest on young growth; hence it is well to cut back the plant severely in spring. Still another shrub useful for such purposes is the red-bud or Judas tree, whose flowers, in a cheery shade of pink, cover the branches before the leaves appear.

At the base of evergreens occasional touches of color, such as are afforded by beds of petunia, canna, salvia, or other bedding plants, are highly effective and satisfactory. Owing to their vigor of growth and ease of culture clumps of many of the perennial plants are exceedingly valuable adjuncts, used in this way, and if left undisturbed they will increase in size and beauty from year to year. Foxglove, platycodon, hardy phlox, larkspur, and a host of others, from which selection may be made according to the planter's fancy, are available for the purpose. In fact, evergreens form a most excellent background for a great variety of charming hues in flower, fruit, and foliage. During the entire cycle of the seasons they may be made to accentuate and brighten an infinite variety of colors in plants, from the humblest flowers to the gorgeous maples.

For making an evergreen hedge American hemlock or Siberian arbor vitæ are recommended, and, if to be shorn into fanciful shapes, the use of common red cedar, blue-tinted cedar, or any arbor vitæ is advised.

It is urged that "every country home should have its shelter belt of evergreens. Wind-breaks are not meant for the sole use of extensive orchardists, as was once thought, but should be so commonly planted as to protect every home exposed in the least to the ravages of wind and storm. * * *"

As a protection to farm buildings, the barnyard, or poultry run, a good wind-break will repay its cost in a few years in the saving of fuel or feed. The length of time consumed in its growth need not deter anyone from making a wind-break, as results may be secured in half a dozen years by planting thickly, subsequent thinning to be practiced.

For the construction of wind-breaks and shelter belts the white pine, Norway spruce, Austrian and Scotch pines, and American arbor vitæ have no superiors. These kinds all grow rapidly and are not lacking in vigor or adaptability to thin soils, exposed situations, and other adverse conditions.

The authors are careful to warn against the exclusive planting of evergreens about homes.

Deciduous trees occupy a place in any scheme for beautifying lawns which conifers alone do not and can not fill. When surrounded and completely enveloped in a dense growth of evergreens, a style of planting somewhat prevalent a few decades ago, and of which examples are even now occasionally seen, a residence becomes dark, gloomy, damp, and dangerous to health.

NUT GROWING IN MARYLAND.[a]

A recent bulletin of the Maryland Station, by C. P. Close, indicates that the possible area of successful nut culture, even of the choice Persian walnuts and pecans, is much more extended than has gen-

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[a] Compiled from Maryland Sta. Bul. 125.

erally been supposed. After a thorough investigation of the subject, Professor Close is of the opinion that "there is scarcely any good reason why people who own favorably located, well-drained land without hardpan subsoil in Maryland should not plant nut trees, especially the Persian walnut and pecan," and he predicts that "in a few years Maryland will rank as a nut-producing State. She has the requisite soil, climate, and incentive, and since satisfactory varieties are to be had, it is now only a question of launching the industry systematically, and this movement has already begun."

Professor Close thinks "the planting of nut trees ought to be encouraged and increased until the nuts are produced in large enough quantities to become a staple article of food instead of only a luxury. They can to a very considerable extent be used in a mixed diet to take the place of meat. At 20 cents per pound for walnuts and 25 cents per pound for porterhouse steak, an equal investment in each will produce about one-fifth more in weight of food material and in energy in the walnuts than in the steak.[a] Pecans rank higher than walnuts in a similar comparison. For use as luxuries only, the addition of thousands of acres of productive nut orchards to our present supply would be profitable."

A nut survey of the State showed that—

> The native black walnut, butternut, hickory, chestnut, beech, hazel, and chinquapin abound almost everywhere. A few of the black walnuts and hickories are of especial merit. * * * Most of the State has produced excellent Persian walnuts and some pecans for more than a hundred years. Only a few named varieties of the improved sorts have thus far been tried. The improved varieties of chestnuts are not generally profitable, but may become so if the immense crop of native chestnuts is cut short, as is now threatened by a disease which is causing the death of hundreds of trees. * * * The Japan walnut is not much grown and is not likely to be.

The following are named as the varieties of Persian walnuts which are believed to be most likely to succeed under Maryland conditions: Chaberte, Franquette, Mayette Blanche, Parisienne, Prœparturiens, San Jose, Rush, Norman Pomeroy, Drew, and Peerless Paper Shell.

It is stated that varieties of pecans adapted to Maryland conditions "can not be recommended with as much certainty as can Persian walnuts, because the pecan has not yet received much attention in localities far north of its native home. From the few efforts at pecan growing already made in the State there is reason to believe that the most hardy varieties will succeed here. The following varieties were suggested by Prof. H. H. Hume, who has had considerable experience with pecans in the Southern States: Curtis, Horlbeck, Mantura, Moneymaker, Pabst, Stuart, and Van Deman."

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[a] See U. S. Dept. Agr., Yearbook, 1906, p. 295.

Professor Close describes methods of propagation, grafting, budding, planting, etc., adapted to Maryland conditions. Conditions similar to those of Maryland prevail over extensive areas in which nut culture is now given little attention. The possibility of profitably extending this industry would therefore seem to be worthy of consideration.

"HOGGING OFF" CORN.[a]

"Hogging off" corn "means, in farm practice, turning the hogs into a field of standing corn, allowing them to pull down the stalks and consume the corn at will." In a recent bulletin of the Minnesota Station, D. A. Gaumnitz and associates say:

> This practice was not uncommon twenty or twenty-five years ago in Ohio. It was not followed extensively, because it appeared to be a shiftless, untidy way of harvesting corn, and it was not believed that the hogs made as good gains as when yard fed or closely confined.
>
> These ideas, combined with a plea by agricultural scientists for better farming, which was supposed to mean cutting and carefully husking the corn, led many to discontinue the practice.
>
> About the time this system of hogging corn was discarded in the East, the western farmers took it up, especially in Illinois, Iowa, Kansas, Nebraska, and Oklahoma. Some have followed it more or less since that time with good results.
>
> Corn is a comparatively cheap feed in the central Western States. An acre of corn can be grown up to harvest for from $4 to $5, and with rental of land added, for about $7.50 to $8.50. With fair yields the cost per bushel is very low. High prices for labor, together with low prices for corn, warrant economy in labor even though it may lead to a slight waste of corn.
>
> The idea that hogging off corn is a shiftless way of farming is based neither on facts nor good judgment. So far as the farmer is concerned, the method that yields the largest net profit and the greatest possibility of enjoyment for himself and family is the best to follow. When it is learned that corn may be economically harvested with live stock and that good timothy and clover hay can be produced as cheaply per ton as corn stover can be saved this idea will change.

These conclusions are based upon experiments made at the Minnesota Experiment Station during 1905 and 1906. The hogs were turned into the corn September 19. It is thought that ordinarily they should be turned in by September 1.

> In 1905 the field pigs took to the hogging down of corn rather rapidly, learning to do it in about three days, but in 1906 it required about a week or ten days for the 112-pound pigs to learn how to break down the corn and find the ears.

Hogs thus fed in the fields wasted no more corn than those fed in the yard. In fact, they picked the corn as clean as most men do in husking. The field hogs, moreover, gained nearly one-third more rapidly than those fed in yards and produced pork with less grain.

The experiments indicate that the labor required in caring for hogs is not increased by hogging corn, but may be decreased if systematic

[a] Compiled from Minnesota Sta. Bul. 104.

methods and a carefully worked out plan with a view to economy of labor and fencing are employed.

It is not expected that all corn raised be fed off with hogs, but the amount they can clean up from the time it is nicely glazed until the weather becomes unfavorable (two or three months in Minnesota) may be very economically fed in this way. Hogs should not, as a rule, be turned into more corn at one time than they can eat up clean in two or three weeks. The shorter period is preferable.

Considerable fencing may be necessary, but the cost of this may be from $1 to $2.50 less per acre than the cost of husking the corn. Fields permanently fenced for hogs should, however, be convenient to the farmstead, as large as can be used for the purpose, and of such shape as to reduce to a minimum the amount of fencing necessary to inclose an acre of land, and it is suggested that 3 pounds of rape, costing 15 cents, sown in the corn at the last cultivation, will furnish considerable succulent feed, which may take the place of high-priced shorts.

It is believed that the stover lost in hogging off corn "is in many cases not worth the cost of saving."

Finally, it is said in favor of the practice that "it requires no more labor to prepare for subsequent crop fields that have been hogged off than those that have been treated by the ordinary methods of harvesting."

IMPORTANCE OF LIME AND OTHER MINERAL MATTER IN FEEDING STUFFS.[a]

The importance of protein or nitrogenous material and of energy-yielding fat and carbohydrates in a ration has often been discussed,[b] and it is almost universally conceded that a definite proportion of protein to energy-yielding constituents—that is, a balanced ration—is essential for the best results. For carrying on life processes other constituents—namely, mineral matters—are equally essential, but the question of ash requirement is less generally insisted upon, perhaps owing to the lack of trustworthy information regarding the kinds and amounts which are essential and the many difficulties attendant upon experimental work along such lines.

Everyone concedes that mineral matter is required for the formation of bones, teeth, and other hard parts of the animal body, and that the various digestive juices, the blood, and other portions of the animal must contain certain mineral constituents in order that their proper functions may be carried on. While opinions differ as to

[a] Compiled from Hawaii Sta. Bul. 13; Transvaal Agr. Jour., 5 (1907), Nos. 19, pp. 647–656; 20, pp. 925–928; 6 (1907), No. 21, pp. 51–65.

[b] See, for instance, U. S. Dept. Agr., Farmers' Buls. 22, 170.

some mineral constituents, the following substances are regarded as essential: Calcium and magnesium phosphate, together with small amounts of carbonates, fluorids, and chlorids, which are present in bones and teeth, and chlorids and hydrochloric acid contained in the gastric juice. Potassium compounds are found in saliva and gastric juice and other secretions, iron in the blood and tissues, and sulphur and phosphorus in the blood, brain, and other organs and tissues, while iodin is present in a small amount in the thyroid gland.

Practically all feeding stuffs contain a variety of ash constituents, vegetable products being the most important source of mineral matter, as they are the principal food supply of domestic animals. Under usual circumstances it is believed that the mixed rations which are most commonly fed will supply the needed mineral matter.

The plants obtain the mineral constituents necessary for their growth from the soil, the proportion of different ash constituents varying in the different plant organs. Prof. H. Ingle, of the Transvaal department of agriculture, in a discussion of this question, states that—

The functions which are filled by the various mineral ingredients are not well known, but they appear to be closely related to the physiological processes by which starch, sugar, albuminoids, and other important products are formed and moved in the plant.

In the most important act of a plant's life—the formation of seed—a concentration of these ash constituents, as well as of the nitrogenous and carbonaceous materials, from the leaves and stems to the seed takes place, in order that the seed may contain a store of plant food to start the seedling when germination occurs.

In this concentration it generally happens that phosphoric acid and potash are stored in largest amount, while lime, magnesia, chlorin, and the other ash constituents, though always present, are there in very small proportion. As a rule, the leaves and stems of a plant contain a higher proportion of these latter elements than the seeds. * * *

Cereals are remarkable for the low proportion of lime to phosphoric acid contained in both their seed and straw. Leguminous plants—e. g., lucern, clover, peas, and beans—contain a high proportion of lime in their leaves and stems. * * * In the straw of cereals and of grasses silica is often the largest constituent, while in leguminosæ and in roots it is present in very small quantity. * * *

Lime and phosphoric acid are required for the formation of bones in animals in the proportion of about 1.5 of lime to 1 of phosphoric acid, and in all probability these are the proportions in which these constituents should be present in the rations of the animals in order to give the most favorable conditions for healthy growth. Animals require for their proper growth supplies of chlorids, fluorids, iron, and probably other substances which may not be present in sufficient quantity in their food.

To cite an instance of the important bearing of ash constituents upon animal production, it seems more than probable that the unsatisfactory results which follow the exclusive feeding of corn to pigs

are not due entirely to a deficiency of protein, as is sometimes claimed, but to a lack of ash constituents. When corn is supplemented by some concentrated feed, such as blood meal, tankage, or alfalfa hay, the ash content of the ration is increased, as well as the protein, and there is reason to believe that the improvement noted is in considerable measure to be ascribed to the increased supply of mineral matter.[a]

To cite another instance, the blue-grass region of Kentucky has long been said to possess peculiar advantages for raising farm animals, particularly horses. In so far as this advantage depends upon feed, it seems likely that it is due to the abundance of lime in the forage crops grown upon the characteristic limestone soil of the blue-grass region.

That the character of the feed and its value for farm animals is dependent in considerable degree upon the mineral character of the soil, and particularly upon the lime content, is clearly shown by the recently published studies of local-grown feeding stuffs, particularly those belonging to the grass family, carried on at the Hawaii Station. In the volcanic soil of the Hawaiian Islands there is little lime, and an examination of the ash constituents showed that Hawaiian forage crops were uniformly deficient in lime, and that the failure to obtain best results which has been noted with an apparently well-balanced ration may be attributed to this cause. In order to secure the best results in bone development, health, etc., Dr. E. C. Shorey, who carried on the studies referred to, believes that these Hawaiian feeding stuffs deficient in lime should be supplemented by others richer in this constituent, such as leguminous plants and sugarhouse by-products, or by the use of some lime in drinking water, mixed with the feeds used, or applied to the soils producing the forage crops.

In connection with Professor Ingle's work, to which reference has already been made, a large number of analyses showed that many of the feeding stuffs grown in the Transvaal were deficient in lime in proportion to phosphoric acid, and he attributes diseases and lack of thrift, often noted in mules and horses, to the fact that the feeding stuffs most commonly used (corn and oat hay) do not provide lime in sufficient amount or in the right proportion to phosphoric acid.

> The usual rations of horses and mules in South Africa are made up of oat hay or oat hay and mealies [Indian corn], and * * * both these foodstuffs contain far too much phosphoric acid in proportion to lime for the probable requirements of animals for healthy bone formation. In Europe and most other parts of the world where oats are used as food for draft animals meadow hay or clover hay is given in addition, and thus the ratio of phosphoric acid to lime in the whole ration is greatly diminished. * * *

[a] See U. S. Dept. Agr., Farmers' Buls. 169, p. 29; 276, p. 21.

The practical deductions to be drawn * * * are that the susceptibility to bone disease in horses, mules, and donkeys [noted in the Transvaal] would be greatly diminished if the present exclusive diet of oat hay or oat hay and mealies were replaced, to some extent at least, by lucern hay, or probably even veld hay, and that a recognition of the need of supplying bone-forming materials—lime and phosphoric acid—in proper proportions in framing rations for animals would undoubtedly lead to greater success in producing sound and healthy stock than at present attends the usual methods of feeding adopted in this country. * * *

Bran and linseed cake, which are rich in ash and therefore generally regarded as being particularly useful in supplying the materials for bone formation, are, from the point of view here explained, particularly unsuitable for this purpose because of the large proportion of phosphorus pentoxid to lime which they contain. The injury to the bones of animals fed largely upon bran has been noticed in the diseases known as "bran rachitis," or "miller's horse disease," and in some respects the effects produced resemble osteoporosis.

As another instance of an attempt to supply a deficiency in mineral matter may be mentioned the custom of feeding broken or crushed bone to cattle as practiced in South Africa. In experiments reported by D. Hutcheon,[a] crushed dried bone about the size of coarse oatmeal, when fed to a steer at the rate of about 1 pound per day for seven days, was apparently completely digested, none of the bone being recovered in the excreta.

Many European investigators have studied the relation of phosphorus and calcium compounds for various farm animals, particularly noteworthy work being that of Gouin and Andouard with calves. The consensus of opinion seems to be that an addition of mineral constituents to the ration is desirable if for any reason enough is not supplied by the ordinary feeds. The deficiency may be made good by the selection of feeding stuffs containing the desired mineral elements in greater abundance or by supplying mixtures of mineral salts, though the advantages of the latter method are perhaps less clearly demonstrated. It will be recalled, however, that such a use of mineral salts is in accord with general agricultural practice, salt, sulphur, wood ashes, and similar material being very commonly given to live stock on many farms.

According to Professor Ingle—

The use of "bone flour" or "bone meal" as a "lick" for cattle in districts in which the soil is deficient in lime, and in which certain bone diseases are prevalent, is much advocated in many quarters, and would appear to be useful. Bone ash would probably be preferable, and its use would avoid the danger of spreading disease which exists when raw bones are employed. Although bones or bone ash contain lime and phosphoric acid in exactly the same proportions that they are required in the building up of the bones of the animals fed upon them, it would seem better to provide a food in which the proportion of

[a] Agr. Jour. Cape Good Hope, 28 (1906), No. 2, pp. 210–212.

lime to phosphoric acid is higher, since the object in view is to amend the too low ratio which exists in the actual food of the animal. * * *

The supply of common salt is absolutely essential, and in districts where this substance does not occur in the soil or water, it is advisable to supply it to animals in the form of "lick." The addition of lime or of bone meal to the "lick" may also be useful, though it is probable that these substances as "lick" are not so effective as when they form actual constituents of the food plants. The same applies to sulphur, which is also often added to "licks." It should be pointed out, however, that, in addition to supplying the physiological requirements of the animals, salt, sulphur, and other additions sometimes made to the "lick" act medicinally, sometimes as vermifuges, sometimes as purgatives. This aspect of the question, however, can not appropriately be discussed here.

Studies of the ash content of farm crops have been an important feature of experiment station work in this country, but the question has been studied more often from the standpoint of the plant's draft upon the soil and hence its fertilizer requirements than from that of the value of the ash as a food material. The latter question would seem to be of sufficient importance to warrant more careful study.

PREPARATION OF MISCIBLE OILS.[a]

The use of refined and crude oils as insecticides for scale insects and other insect pests has been quite generally adopted among orchardists for many years. The efficiency of these oils in destroying insects is well known, but when used at too great a strength they may injure fruit trees, especially if applied during the growing period or for many years in succession during the dormant season. It is, therefore, a matter of much practical importance to devise means of mixing oils with water so that they may be diluted as greatly as is consistent with efficiency. The mechanical mixture of oils with water by means of special machinery has not given satisfactory results. Resort has, therefore, been had to different methods of preparing emulsions, ordinary kerosene emulsion being the most familiar example of this sort of mixture.

In order to get satisfactory results from kerosene emulsion it is necessary to use a preparation carrying about 20 per cent of oil. This, however, appears to be too high a percentage of oil for safety in continued use on fruit trees. Recently much interest has been aroused in improved methods of preparing a miscible oil by emulsifying heavy or crude oils. A number of proprietary mixtures of this sort have been put on the market and have given reasonable satisfaction, but are too expensive. In view of the importance of the matter,

[a] Compiled from Delaware Sta. Bul. 75; Circ. 1; New Jersey Stas. Rpt. 1904, p. 644; 1905, p. 615; 1906, p. 587; Pennsylvania Sta. Bul. 86; U. S. Dept. Agr., Farmers' Bul. 127.

Prof. C. L. Penny, formerly of the Delaware Station and now of the Pennsylvania Station, has devoted a great amount of attention to devising a good method for emulsifying heavy oils. The method as worked out by Professor Penny is briefly as follows: In the preparation of a soap solution to be used as an emulsifier 10 gallons of menhaden oil, 8 gallons of carbolic acid, and 15 pounds of caustic potash are heated in an iron kettle or some other kind of cooking apparatus to a temperature of 290° or 300° F. The mixture is stirred at first to prevent the potash from caking on the bottom of the kettle. As soon as the required temperature is reached heating is discontinued and 2 gallons of kerosene are added at once. As soon as the temperature of the mixture falls below 212° F. 2 gallons of water are added. The mixture is then well stirred, and constitutes the soap solution or emulsifier. This solution pours readily at all temperatures above the freezing point. It does not deteriorate if kept over from one season to another.

The soap solution or emulsifier is then used for emulsifying a suitable quantity of oil. The emulsifier may be used in making a miscible oil with kerosene or crude petroleum. A considerable variety of formulas have been tested by Professor Penny, but the one which gave the best results called for 40 gallons paraffin oil and 6 gallons of rosin oil for each $3\frac{2}{3}$ gallons of the soap solution. A small amount of water, which appears to vary slightly according to the quality of the materials used, is added in every case as required by test. Professor Penny has found that the addition of water assists in perfecting the emulsion. If after the soap solution and oils have been mixed there is a tendency to separate to some extent into two layers, the addition of a gallon, more or less, of water may produce a perfect emulsion.

The third stage in the preparation of miscible oils for spraying is the dilution of the miscible-oil mixture just described with water before applying to the trees. If the formulas mentioned above are adopted, 1 gallon of the emulsifier will make from 8 to 14 gallons of miscible oil, and this quantity in turn will make from 100 to 210 gallons of diluted emulsion ready to apply to fruit trees. In an iron kettle large enough to boil 30 gallons of the soap solution enough of this material can be prepared at one boiling to produce 4,000 gallons or more of emulsion upon dilution. The diluted emulsion appears to be efficient in the destruction of scale insects if it contains 10 per cent or even less of oil. The cost of such a spraying material is about 1 cent per gallon as compared with one-half to 1 cent for lime-sulphur.

If any trouble should be experienced in obtaining a perfect emulsion before the final dilution with water, Professor Penny recommends that the amount of water should be varied, and that if this does not give the desired result the amount of rosin oil should be reduced. As a last resort the amount of soap may be increased. As soon, however, as the proper proportions are determined for any particular grade of materials no further trouble should be experienced.

The chief advantages of miscible oils over other insecticides for use in scale insects are their relative harmlessness when coming in contact with workmen and apparatus, and also the fact that they are always ready for use without the further application of heat. If the individual fruit raiser should not think it advisable to provide a suitable apparatus, it has been suggested that the soap solution might be prepared at a central point for shipment to the fruit growers of the neighborhood.

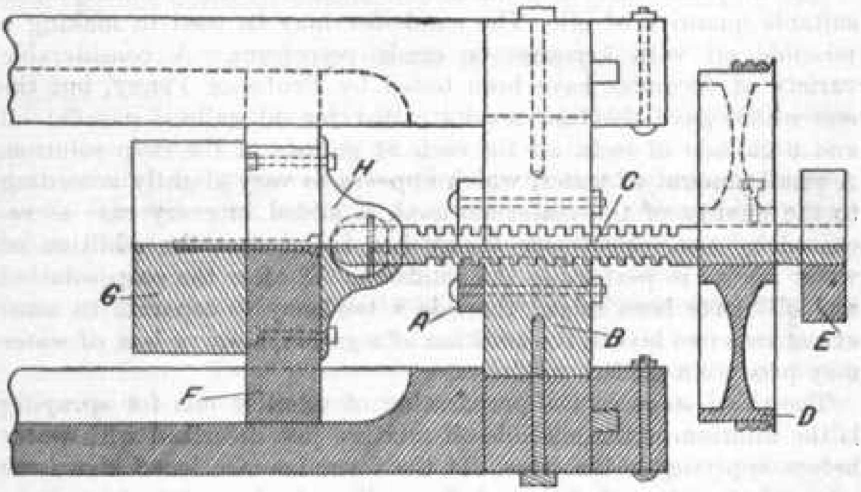

FIG. 3.—The self-acting parts of an automatic cheese press.

AN AUTOMATIC CHEESE PRESS.[a]

Various presses designed to secure continuous pressure and thus insure a well-closed cheese are on the market, but in the course of investigations on cheese making carried on by J. W. Moore, of the Wisconsin Station, in cooperation with the Dairy Division of this Department, it was found desirable to modify the ordinary forms of presses in order to maintain automatically a constant pressure for any desired length of time. The construction of the form of press adopted is shown in cross section in figure 3.

[a] Compiled from Wisconsin Sta. Rpt. 1907, p. 207.

A threaded nut (A) is set into the crosspiece (B) at the end of the press. A screw (C), taken from an old vertical cheese press, works through the nut and the crosspiece. A pulley (D) is attached rigidly to the screw (C) near its outer end.

The journal (E) is set in a plank fastened to the floor; the other end of the screw fits into a swivel (H) which presses against the guide (F).

The head block (G) is attached to the guide (F) by means of a lag screw. The screw (C) is 1⅝ inches in diameter and has three coils of thread to the inch. The pulley (D) is 13 inches in diameter.

The guide slides forward in the grooves when the pulley is turned.

A rope, wrapped several times around the pulley, passes through a small pulley fixed to a beam overhead. Weights are attached to the rope to produce any desired pressure on the cheese in the press. (Fig. 4.)

In several months' tests of the press cheeses were taken from it daily which were uniformly free from mechanical openings, a quality desired by every cheese maker.

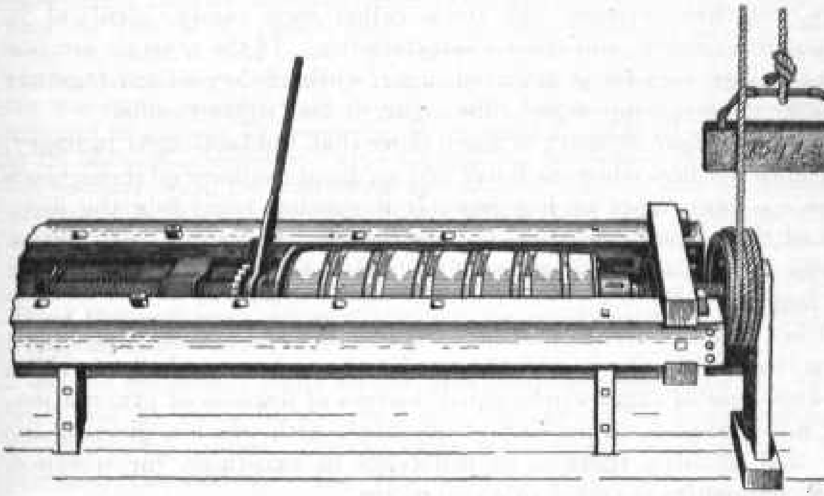

FIG. 4.—Automatic cheese press. The 140-pound weight attached to a rope passing over a pulley attached to the ceiling of the room moves the screw which keeps the pressure constant.

"The results of several months of experimenting indicate that about 48 pounds per square inch on the end of the cheese is sufficient to close any curd, even if very firm, provided that it has been properly handled before pressing."

The advantages of using such a press in the ordinary American Cheddar cheese factory are in brief as follows: By its use "the cheese can be put under any required pressure. By insuring continuous pressure during the night the cheeses are more perfectly closed than is otherwise possible. When the continuous-pressure device is used there is less loss of fat, because a lower pressure is applied to the warm curd than is required with the ordinary press."

CANE SUGAR AND BEET SUGAR FOR CANNING AND JELLY MAKING.[a]

Chemists generally concede that the sugar which occurs in the sugar cane is identical from the standpoint of chemical composition and structure with that found in the sugar maple, sugar beet, and many other vegetable products. As it occurs in nature, the sugar is accompanied by various other materials dissolved in the plant juice, and it is the presence of more or less of such bodies which gives certain commercial sugar products, like molasses and maple sirup, their distinctive flavor.

Old-fashioned brown sugar, maple sugar, crude beet sugar, butternut sugar, and other similar sugars differ in appearance, flavor, and palatability, owing to the character of the plant products which remain with the sugar, but from all of them it is possible to obtain pure, colorless crystals, like those called rock candy, identical in appearance, flavor, and other characteristics. If the crystals are fine and separate, we have granulated sugar, while if they adhere together in large masses, lump sugar, cube sugar, or loaf sugar results.

The cane-sugar industry is much older than the beet-sugar industry, and since the days when the latter first assumed commercial importance there has been more or less popular discussion regarding the identity of the sugar from these two sources and regarding the relative merits for household purposes of the two sorts as they are found on the market.

It has often been said that beet sugar is not as sweet as cane sugar, notwithstanding the fact that chemists have known that, provided the two sorts of sugar are of equal degrees of fineness of granulation, and hence alike as to the ease or quickness with which a given quantity will dissolve, there is no difference in sweetness, for instance, when a spoonful is added to a cup of tea.

Another common statement is that beet sugar can not be used successfully for canning, jelly making, and preserving. In earlier times, before methods of refining had been perfected, there may have been some warrant for such a belief, but methods of purifying beet sugar were long ago perfected and such sugar has been used for many years in this country and Europe for all household purposes.

In this connection, tests recently carried on at the California Experiment Station by G. W. Shaw, in which beet sugar and cane sugar were compared under factory and domestic conditions for preserving, are of interest.

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[a] Compiled from California Sta. Circ. 33, p. 4.

The fruits used in the tests, carried out on a commercial scale, were cherries, apricots, plums, peaches, and pears. Each of these was preserved in sirup of different strength by the usual methods. In making the sirups used with the fruit some differences in the action of different grades of sugar were noted.

The beet sugar caused the more froth in the making of sirup, but further investigation led to the conclusion that this was due to the fact that the granulation of the beet sugar was much finer than that of the cane, therefore causing more air to become entangled during the stirring than in the case of the sugar from cane. This was shown by the use of cane sugar of about the same granulation in another batch of sirup, in which case the same frothing occurred as with the beet product. This has been noted in other instances, and canners are wont to count this against the beet sugar, but it is only the result of not comparing sugars of the same granulation. This difference in the action due to difference of granulation was the only apparent difference arising during the making of the sirup. This is not an essential difference between these sugars, however, as the character of the granulation is entirely dependent upon the wish of the manufacturer, the methods of boiling and granulation being the same in both cases. The sugar ordinarily used by the canners is known as dry, coarse, granulated—a grade which is not commonly made by the beet-sugar manufacturers, because there has not yet been the demand sufficient to warrant its production, but it could be made by them as readily as the ordinary granulation. After canning, the fruits were stored in cases in the ordinary way, the cans being opened from time to time to determine whether any change had taken place. Of the 2,000 cans which were thus treated only 6 cans from the beet-sugar lot and 7 from the cane-sugar lot spoiled during the two years, and these were evidently due to imperfect sealing of the cans, thus showing the utter lack of foundation for the idea that fruits do not keep well when preserved with beet sugar and that such sugar does not work well in the cannery.

In the household trials 40 per cent sirup was used and the fruits were put up in ordinary glass jars, 50 jars of both apricots and peaches being canned. "From these not a single can spoiled during the two-year period." The two sorts of sugar gave equally good results.

For the jelly-making trials apples and currants were selected, equal quantities of juice and sugar, either beet or cane, being used and the mixture boiled until of the right consistency to jelly. "The product in each case was as clear as it is possible for jelly to be, and not the slightest difficulty was experienced in the making of it."

In connection with the experimental tests an attempt was made to trace numerous reports to the effect that fruit had been lost through the use of beet sugar in canning, but in no instance was this found to be the case, though numerous letters were received in reply to inquiries which were sent out.

The utter folly of this idea that beet sugar can not be used for canning purposes is further emphasized by the fact that practically all the sugar used in

Germany and France for the purposes of canning and preserving is from the beet, and for many years American refined beet sugar was used without complaint in this country, because the mass of the people were not aware that it was derived from the beet. This sugar was brought here as raw sugar from Europe and refined at American refineries.

Professor Shaw concludes from his experimental data and other evidence that under both commercial and household conditions beet sugar and cane sugar give equally satisfactory results for canning fruit and also for jelly making.

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